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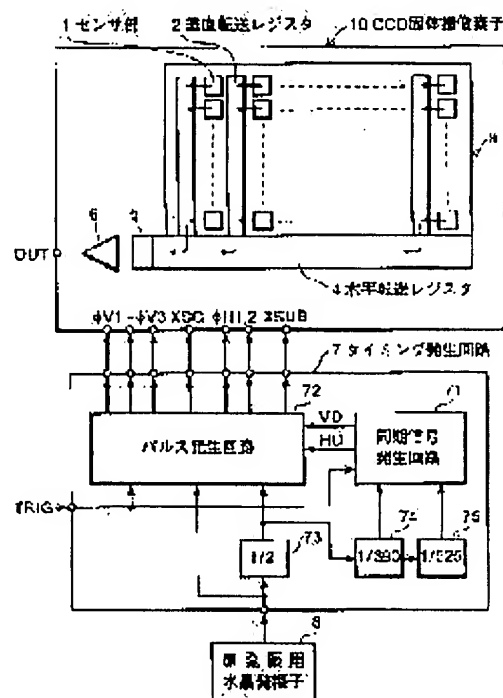
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(54) TIMING GENERATION CIRCUIT, SOLID-STATE IMAGE PICKUP DEVICE USING THE CIRCUIT, VIDEO CAMERA EQUIPPED WITH THE DEVICE AND DRIVING METHOD FOR SOLID-STATE IMAGE PICKUP ELEMENT

(57)Abstract:

PURPOSE: To control accurately an exposure start timing and an exposure time by generating a shutter pulse in the same timing as an input timing of an external trigger so as to start exposure and terminating the exposure by a charge read pulse after a prescribed time.

CONSTITUTION: A synchronizing signal generation circuit 71 generates a horizontal synchronizing pulse HD in the random trigger shutter mode in the solid-state image pickup element having an electronic shutter function, a pulse generation circuit 72 generates a shutter pulse XSUB for each 1H synchronously with the HD to throw away storage charge of a sensor section 1. Upon the receipt of a trigger TRIG externally, the synchronizing signal generation circuit 71 resets the HD at its trailing and the pulse generation circuit 72 resets the XSUB simultaneously to throw away the charge of the sensor section 1 and to start exposure. After the set exposure time, an XSG is generated to allow a vertical transfer register 2 to read the charge of the sensor section 1 and transferred and the exposure is finished.



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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Industrial Application] This invention relates to the actuation approach of the timing generating circuit concerning the solid state image pickup device which performs exposure actuation, and its solid state image pickup device by inputting especially a trigger at random from the exterior about the actuation approach of the timing generating circuit for driving the solid state image pickup device which has electronic shutter ability, and its solid state image pickup device.

[0002]

[Description of the Prior Art] There are some solid state image pickup devices which have electronic shutter ability and which have the so-called random trigger shutter function to perform exposure actuation by inputting a trigger at random from the exterior. For example, in FA (Factory Automation) application, the video camera carrying this kind of solid state image pickup device is installed near the works, for example, a band conveyor, and is used. That is, by a sensor's detecting that the photography object came in front of the video camera, and giving the detection output in it to a video camera as a trigger, the photography object on a band conveyor is photoed and the image is projected on monitor display.

[0003] Drawing 4 is a timing chart for explaining random trigger shutter actuation of the 1 conventional example. In this conventional example, if external trigger TRIG is inputted, that external trigger TRIG will be incorporated by horizontal synchronizing pulse HD, and exposure will be started. That is, by continuing generating the shutter pulse XSUB synchronizing with this horizontal synchronizing pulse HD, the signal charge accumulated in the sensor section sweeps, **** is performed repeatedly, and exposure (are recording of a signal charge) is started from the final event of sweeping and **** being completed until horizontal synchronizing pulse HD of the beginning after the input of external trigger TRIG is generated. And are recording of a signal charge is performed only for the exposure time set up from exposure initiation corresponding to desired shutter speed, if the exposure time passes, the charge read pulse XSG will be generated synchronizing with horizontal synchronizing pulse HD, and reading appearance of the signal charge accumulated in the sensor section is carried out to a vertical transfer register.

[0004] Drawing 5 is a timing chart for explaining random trigger shutter actuation of other conventional examples. In this conventional example, if external trigger TRIG is inputted, the shutter pulse XSUB generated synchronizing with horizontal synchronizing pulse HD will be reset, and exposure will be started from that event. that is, the shutter pulse XSUB is reset and final, when the signal charge accumulated in the sensor section by continuing generating the shutter pulse XSUB synchronizing with horizontal synchronizing pulse HD sweeps, **** is performed repeatedly and external trigger TRIG is inputted until external trigger TRIG is inputted -- it sweeps, **** is performed and exposure is started from the event. And are recording of a signal charge is performed only for the exposure time set up from exposure initiation corresponding to desired shutter speed, if the exposure time passes, the charge read pulse XSG will be generated synchronizing with horizontal synchronizing pulse HD, and reading appearance of the signal charge accumulated in the sensor section is carried out to a vertical transfer register.

[0005]

[Problem(s) to be Solved by the Invention] However, if it is in the former conventional example, although it is always fixed, since exposure is always started to the timing of the fall of horizontal synchronizing pulse HD regardless of the input timing of external trigger TRIG, after external trigger TRIG inputs from the exposure time becoming settled in horizontal synchronizing pulse HD before exposure begins, time difference will occur, and exposure initiation timing will vary. That is, in drawing 4, even the fall of the shutter pulse XSUB serves as time difference to exposure initiation from the fall of external trigger TRIG. Thus, when exposure initiation timing varies, in application for FA application which carried out point **, for example, the image of a photography object will project up within a monitoring screen,

or it will project caudad, and the nonconformity that the display position does not become settled will occur.

[0006] On the other hand, although exposure initiation timing is decided by input timing of external trigger TRIG, since exposure termination timing becomes settled in horizontal synchronizing pulse HD in the latter conventional example, as shown in drawing 5, the exposure time will vary by the input timing of external trigger TRIG. Thus, if the exposure time varies, the image of a photography object will become bright, or it will become dark, and the nonconformity that the brightness does not become settled will occur. This becomes more remarkable, as the exposure time becomes short.

[0007] This invention is made in view of the above-mentioned technical problem, and the place made into the object is in the solid state image pickup device which has electronic shutter ability to offer the actuation approach of of the solid state camera and solid state image pickup device using the timing generating circuit which can control the exposure initiation timing and exposure time to accuracy, and this.

[0008]

[Means for Solving the Problem] Since the solid state image pickup device which has electronic shutter ability is driven, the timing generating circuit by this invention While being the timing generating circuit which generates various kinds of timing pulses containing a shutter pulse and a charge read pulse and generating a horizontal synchronizing pulse and a vertical synchronizing pulse based on a reference frequency signal While generating various kinds of timing pulses based on the synchronizing signal generating circuit which resets a horizontal synchronizing pulse, a reference frequency signal and a horizontal synchronizing pulse, and a vertical synchronizing pulse to the timing into which the external trigger was inputted When the shutter pulse was generated to the reset timing of the Horizontal Synchronizing signal in a synchronizing signal generating circuit and fixed time amount has passed since the generating event, it has composition equipped with the pulse generating circuit which generates a charge read pulse.

[0009]

[Function] In the timing generating circuit of the above-mentioned configuration, a synchronizing signal generating circuit will reset a horizontal synchronizing pulse to the input timing, if an external trigger is inputted. If a horizontal synchronizing pulse is reset, a pulse generating circuit will reset the shutter pulse generated synchronizing with a horizontal synchronizing pulse to reset and this timing of a horizontal synchronizing pulse. This generates a shutter pulse to the input timing and this timing of an external trigger. That is, exposure is started from the event of an external trigger being inputted. And a pulse generating circuit generates a charge read pulse, when fixed time amount (exposure time) has passed since exposure initiation. Thereby, exposure is completed.

[0010]

[Example] Hereafter, it explains to a detail, referring to a drawing about the example of this invention.

[0011] Drawing 1 is the block diagram showing one example of this invention applied to the CCD solid state image pickup device of for example, the INTARAIN transmittal mode. The image pick-up field 3 is constituted in drawing 1 by two or more sensor sections (photoelectrical converter) 1 which are arranged in the shape of a matrix and accumulate the signal charge according to the amount of incident light in a line writing direction (perpendicular direction) and the direction of a train (horizontal), and two or more vertical transfer registers 2 which carry out the vertical transfer of the signal charge by which was arranged for every vertical file of these sensors section 1, and reading appearance was carried out from each sensor section 1.

[0012] In this image pick-up field 3, the sensor section 1 consists of a photodiode of a PN junction, and the vertical transfer register 2 is constituted by CCD. Reading appearance of the signal charge accumulated in the sensor section 1 is carried out to the vertical transfer register 3 by impressing the charge read pulse XSG to the read-out gate which is not illustrated. Transfer actuation of the vertical transfer register 3 is carried out by the vertical transfer clock $\phi V1$ to $\phi V3$ of a three phase circuit. In addition, actuation of the vertical transfer register 3 is not restricted to a three-phase drive, and it is needless to say that you may be a four-phase drive etc. The signal charge by which reading appearance was carried out to the vertical transfer register 3 is perpendicularly transmitted in order of partial [which is equivalent to the 1 scanning line at a part of level blanking period / every].

[0013] The level transfer register 4 with which the signal charge which is equivalent to the 1 scanning line from two or more vertical transfer registers 3 becomes the bottom on the drawing of the image pick-up field 3 from CCD by which a sequential transfer is carried out is arranged. Transfer actuation of this level transfer register 4 is carried out by the level transfer clock $\phi H1$ of two phases, and $\phi H2$. Thereby, the signal charge for the 1 scanning line is horizontally transmitted one by one in the horizontal scanning period after a level blanking period. The charge detecting element 5 of a floating diffusion configuration is allotted to the edge of the level transfer register 4, and the signal charge by which the level transfer was carried out is changed into a voltage signal one by one by this charge detecting element 5. And this voltage signal is drawn as an image pick-up output OUT according to the amount of incidence of the light from a photographic subject, after being amplified with the output amplifier 6.

[0014] The CCD solid state image pickup device 10 of the above-mentioned configuration impresses the shutter pulse (charge ***** pulse) XSUB to a substrate, and has composition in which the electronic shutter actuation which controls the storage time (exposure time) of the signal charge in the sensor section 1 is possible by making a substrate sweep out the signal charge accumulated in each sensor section 1. That is, to a signal charge being accumulated in the sensor section 1, by adding the shutter pulse XSUB to a substrate electrical potential difference further, the barrier by the side of a substrate collapses, and the signal charge accumulated in the sensor section 1 is swept out to a substrate at the time of electronic shutter actuation by carrying out bias of the substrate by the fixed programmed voltage (substrate electrical potential difference) at the time of the usual actuation.

[0015] Various kinds of timing pulses, such as the vertical transfer clock $\phi V1$ to $\phi V3$ of a three phase circuit, the charge read pulse XSG, the level transfer clock $\phi H1$ of two phases, $\phi H2$, and the shutter pulse XSUB, are generated in the timing generating circuit 7 based on the 24.5454MHz original oscillation signalling frequency (reference frequency signal) supplied from the crystal oscillator 8 for a original oscillation. This timing generating circuit 7 considers the synchronizing signal generating circuit 71 which generates horizontal synchronizing pulse HD and a vertical synchronizing pulse VD, and the pulse generating circuit 72 which generates various kinds of timing pulses as a basic configuration, for example, is formed into 1 chip.

[0016] While 1 / 2 dividing of the 24.5454MHz original oscillation signalling frequency are carried out with 1/2 counting-down circuit 73 and a pulse generating circuit 72 is supplied as a 12.2727MHz master clock in this timing generating circuit 7 1/390 counting-down circuit 74 -- further -- 1 / 390 dividing are carried out -- having -- as 31.5kHz twice [with a horizontal scan frequency of 15.75kHz] as many signalling frequency as this -- further -- 1 / 525 dividing are carried out with 1/525 counting-down circuit 75, and the synchronizing signal generating circuit 71 is supplied as 60Hz signalling frequency. Moreover, external trigger TRIG for random trigger shutter actuation is impressed to the synchronizing signal generating circuit 71 and a pulse generating circuit 72.

[0017] The synchronizing signal generating circuit 71 will reset horizontal synchronizing pulse HD to the input timing, if external trigger TRIG is inputted while generating a vertical synchronizing pulse VD for horizontal synchronizing pulse HD based on 60Hz signalling frequency based on 31.5kHz signalling frequency, respectively. On the other hand, if external trigger TRIG is inputted while generating the vertical transfer clock $\phi V1$ to $\phi V3$ of a three phase circuit, the level transfer clock $\phi H1$ of two phases, and various kinds of timing pulses of $\phi H2$ grade based on a 12.25MHz master clock, horizontal synchronizing pulse HD, and a vertical synchronizing pulse VD, a pulse generating circuit 72 will reset the shutter pulse XSUB to the input timing (reset timing of horizontal synchronizing pulse HD), and will generate the final shutter pulse XSUB. Furthermore, when the exposure time decided by a certain shutter speed from reset of horizontal synchronizing pulse HD passes, the charge read pulse XSG is generated.

[0018] Next, the actuation at the time of the random trigger shutter mode in the CCD solid state camera using the timing generating circuit 7 of the above-mentioned configuration is explained based on the timing chart of drawing 2 . In addition, in drawing 2 , ID is a line recognition signal which identifies odd lines / even lines. In the timing generating circuit 7, the change in random trigger shutter mode from the usual continuous action mode is performed by the mode circuit changing switch which is not illustrated.

[0019] If it shifts to random trigger shutter mode from the usual continuous action mode, the synchronizing signal generating circuit 71 generates only horizontal synchronizing pulse HD, and it will suspend generating of a vertical synchronizing pulse VD until external trigger TRIG is inputted. The charge read pulse XSG is also stopped in connection with this. A pulse generating circuit 72 generates the shutter pulse XSUB which is a charge ***** pulse in every 1H (H is a horizontal scanning period) synchronizing with horizontal synchronizing pulse HD. Thereby, in the CCD solid state image pickup device 10, the signal charge accumulated in each sensor section 1 will be in the condition of always being swept and thrown away into a substrate. Moreover, since the vertical transfer clock $\phi V1$ to $\phi V3$ is also generated from a pulse generating circuit 72 and the vertical transfer register 2 is in a transfer condition, the dark signal (dark current in a vertical transfer electrode) of the vertical transfer register 2 will also be eliminated.

[0020] If the trigger TRIG of arbitration is inputted from the exterior in this condition, the synchronizing signal generating circuit 71 will reset horizontal synchronizing pulse HD compulsorily in the fall of this external trigger TRIG. Simultaneously, a pulse generating circuit 72 resets the shutter pulse XSUB, throws away into a substrate the signal charge which generated the final shutter pulse XSUB to the timing, and was accumulated in the sensor section 1, and suspends generating of the shutter pulse XSUB after it. Moreover, the vertical transfer clock $\phi V1$ to $\phi V3$ is also reset according to horizontal synchronizing pulse HD. Exposure is started from this event.

[0021] If the exposure time corresponding to the shutter speed set up beforehand passes since exposure initiation, as for a pulse generating circuit 72, the charge read pulse XSG will be generated. Reading appearance of the signal charge accumulated in each sensor section 1 is carried out to the vertical transfer register 2 through the read-out gate which is

not illustrated by this, and a gentle transfer is performed. Thereby, exposure is completed. The charge read pulse XSG at this time does not depend on a vertical synchronizing pulse VD, but when the exposure time set up by the usual electronic shutter based on horizontal synchronizing pulse HD passes, it is generated.

[0022] Since exposure is always started to the input timing of external trigger TRIG by generating the charge read pulse XSG and having ended exposure when the shutter pulse XSUB was generated to the input timing and this timing of external trigger TRIG, exposure was started and fixed time amount (exposure time) has passed since the exposure initiation as mentioned above, exposure initiation timing is exact. Moreover, in order to reset horizontal synchronizing pulse HD according to the fall of external trigger TRIG, the exposure time controlled per H is also exact.

[0023] Drawing 3 is the block diagram of an example of a video camera which carried the CCD solid state camera of the above-mentioned configuration. In drawing 3, after the light from a photographic subject is incorporated with a lens 31 and passes through a light filter 32, incidence of it is carried out to the image pick-up field 3 (refer to drawing 1) of the CCD solid state image pickup device 10 of the above-mentioned configuration. This CCD solid state image pickup device 10 is driven by various kinds of timing pulses generated from the timing generating circuit 7 mentioned above. The image pick-up output drawn from the CCD solid state image pickup device 10 is outputted as a video signal, after signal processing, such as a correlation duplex sampling (CDS), is made by the digital disposal circuit 33.

[0024] The video camera carrying the CCD solid state camera which has this random trigger shutter function is the best for for example, FA application. Namely, are arranged near the works, for example, a band conveyor, and when setting to external trigger TRIG the detection output of the sensor which detects that the photography object came in front of the video camera, it sets. Even if it is in the condition, i.e., the condition which the photography object is not moving periodically, that the photography object is not flowing the band-conveyor top at fixed spacing, when a photography object passes through a video camera front, exposure can be started, and the image can always be captured by the fixed exposure time. Therefore, the image of a photography object can always be projected on the middle of a monitoring screen with fixed brightness.

[0025] Moreover, the image data of the photography object which is flowing to the period of television signals, such as EIA, asynchronous at high speed can be incorporated on the stable exposure conditions. Furthermore, not only for FA application but for an image-processing application, when capturing an image to the time amount of a certain arbitration, it will become the optimal.

[0026]

[Effect of the Invention] Since according to this invention a charge read pulse is generated and exposure was ended when the shutter pulse was generated to the input timing and this timing of an external trigger, exposure was started in the solid state image pickup device which has electronic shutter ability and fixed time amount had passed since the exposure initiation as explained above, it becomes possible to control the exposure initiation timing and exposure time to accuracy.

[Translation done.]

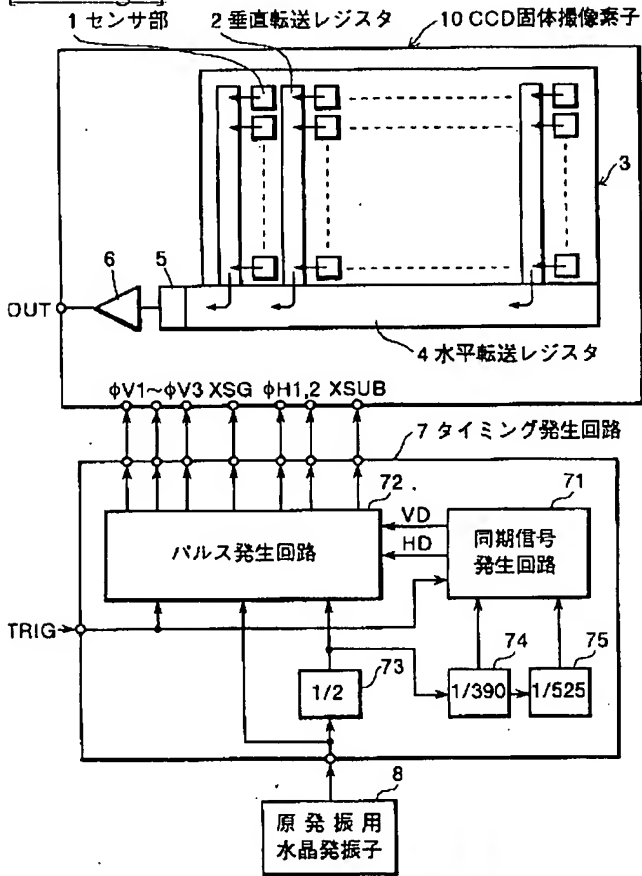
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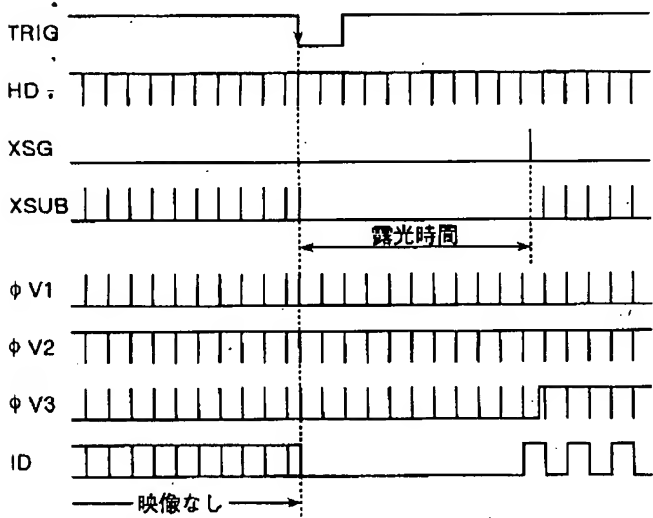
DRAWINGS

[Drawing 1]

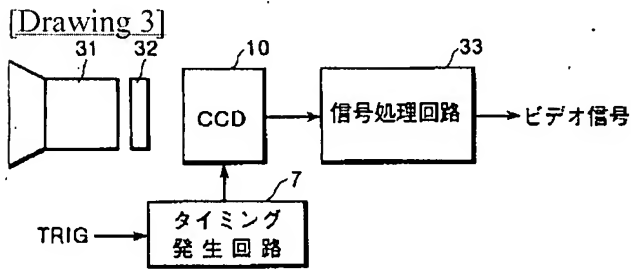


本発明の一実施例を示す構成図

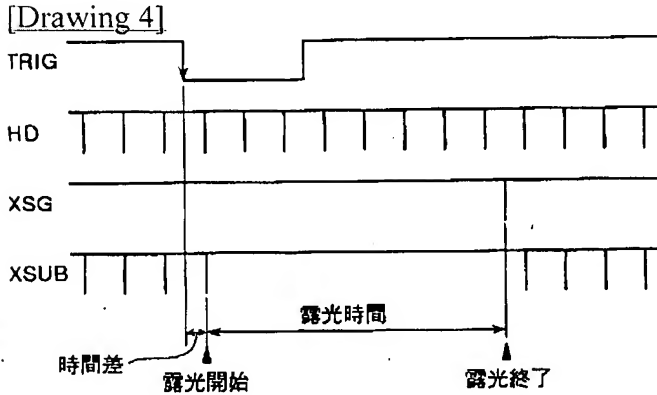
[Drawing 2]



ランダムトリガシャッターモード時のタイミングチャート

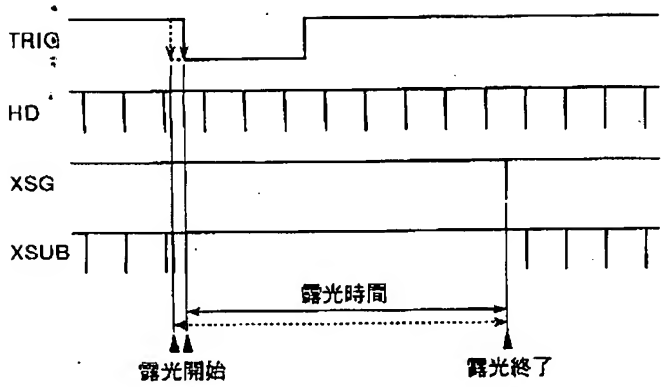


ビデオカメラの構成図



—従来例のタイミングチャート

[Drawing 5]



他の従来例のタイミングチャート

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